Reviews and Abstracts: Vol. 1, No. 1

Analog Computer Techniques

1:

Lanin, N. D., A pneumatic computer of continuous operation, *Priborostroyeniye*, 1959, Nr 7, 3–6. (Russian)

At the Scientific Research Institute for Overall Automation (Nauchno-issledovatel'skiy institut kompleksnoy avtomatizatsii) a pneumatic computer of continuous operation using pneumatic regulators of the aggregate unit system (AUS) was developed. The machine was designed for the solving of linear differential equations with constant coefficients and is suited for the application of similarity of automatic regulating systems. Figure 1 shows the principal elements of this computer, which consists essentially of a summator and an integrator, in form of a scheme. The basic mode of operation of these principal elements is discussed, after which the basic scheme of the integrator is dealt with. The latter consists of an aperiodic element, an amplifying element, and of a summation block, and on the basis of figures 3 and 4 the mode of operation of the integrator is discussed. This computer PVM-1, the entire wiring scheme of which is shown in figure 5, is suited for the solution of differential equations of the sixth order. As the computer works with overpressure, the zero-value is adjusted at 0.5 atm. The experimental machine, which is produced at the TsNIIKA, is shown in figure 7, and in figure 9 the graphical solution, the analytical solution, and the solution obtained by the here-described method of a differential equation of the third order are compared, and the maximum error is given as amounting to 2.5%. Finally, it is found that the computer PVM-1 is suited for the control of technological processes and may form the basis for the development of control machines at industrial plants. (*Translated from the Abstract*)

2:

Mishustin, I. A., A circuit for taking powers (Ob odnoy skheme potentsirovaniya). *Pribory i tekhnika eksperimenta*, 1959, Nr 2, 115–116. (Russian)

The voltage-current characteristic of a diode is often used for taking the logarithm of an analogue quantity in order to compress a dynamic range. The circuit of figure 1 may be employed for the inverse operation of taking antilogarithms of analogue quantities. It is based on the relationship, described in Ref. 2, between the grid current and anode voltage for a pentode with negative anode supply and positive bias. With a 6SK7 valve for example, a useful 12–15 db range is available. Figure 2 shows the performance of the 6K3 valve. The output is a voltage across a series grid resistor which should not exceed 3–5 kilohms. A useful ambit of 60 db can be obtained, the maximum voltage being about 0.2 V. It is a disadvantage of the circuit that this level cannot be much exceeded. There is also considerable variation in performance among valves of the same type. (*Translated from the Abstract*)

Computer Process Control

3:

Karibskiy, V. V., An interpolator of the second order for systems of the digital program control (Interpolyator vtorogo poryadka dlya sistem tsifrovogo programmnogo upravleniya). *Priborostroyeniye*, 1959, Nr 6, 7–10. (Russian)

A description is given of the circuit diagram and algorithm of an interpolator which controls the movement of a tool along a parabola. Proceeding from Newton's interpolation formula a computation course is derived for the circuit diagram, which indicates the pulses for the value increase of $\Delta^2 y$ for equal intervals of x. The variation of the $\Delta^2 y$ value takes place in whole units, the fractional values are accumulated and after reaching a whole unit they are delivered as additional pulses. A table contains the $\Delta^2 y$ values in the decimal and the binary systems as well as the accumulation of the fractional sums and the delivery of the additional impulse as soon as the fraction exceeds the unit. There are four figures and one table. (*Translated from the Abstract*)

Digital Computer Systems

4:

Makhmudov, Yu. A., A compact universal digital computer used on magnetic (ferrite) elements type LEM-1 (Malogabaritnaya universal'naya tsifrovaya vychislitel'naya mashina na magnitnykh (ferritovykh) elementakh LEM-1). *Radiotekhnika*, 1959. *14*, Nr 3, 47–57. (Russian)

The paper gives a brief description of the universal digital computer developed by the Laboratory of Electric Simulation, VINITI, AN, SSSR, under the direction of Prof. Gutenmakher, L. I. The computer uses selenium diodes in the coupling circuits of the magnetic elements. The binary system is employed with a fixed decimal point. The memory of the computer consists of a permanent memory unit with 7,161 addresses and an operational memory unit with 1,024 addresses. A block diagram is given of the device. The features of the device are given as follows: (1) the fluctuation of the current supply below ±20 percent does not affect the computer performance;

(2) the large memory capacity makes it possible to solve problems with a large quantity of original data; (3) the computer can carry out several operations simultaneously, completing 1,200 additions, 600 multiplications, or 200 divisions in a second. *(Translated from the Abstract)*

Digital Computer Programming

5:

Thüring, Bruno., Einführung in die Methoden der Programmierung kaufmännischer und wissenschaftlicher Probleme für elektronische Rechenanlagen. Teil 2: Automatische Programmierung dargestellt an der Univac Fac-Tronic. Robert Göller Verlag, Baden-Baden, 1958. 169 pp. DM 30.00.

This book is the second volume of two by Thüring; the other is reviewed in (MR *20*, 1432). This volume departs from the previous "algorithmic" approach to concentrate on usage of the Univac I digital computer. The first half of the book gives the instruction code and programming details for that machine.

The second half gives a very thorough account of a most important development in digital computer programming, the "GP Compiler" (Generalized Programming) developed by A. Holt and W. Turanski for the Univac I. This latter program is a translater and assembly program (compiler) that allows any program written for the machine to be filed away automatically in a library for later call in by future programs. The mechanics of tying together variables with different names in different programs is described as being performed automatically during the translation and assembly of a "main program" or algorithm. Although other features, including automatic symbolic address assignment, are present, the automatic library making feature is by far the greatest contribution of this procedure. The author gives a thorough account of programs written in this language and their translation, and lists the library for the system at the time of publication. *John W. Carr III*, Chapel Hill, N.C.
(Courtesy *Math. Reviews*)

6:

Korolyuk, V. S. On a method of programming. *Dopovidi Akad. Nauk Ukrain. RSR* 1958, 1292–1295. (Ukrainian, Russian, and English summaries)

This paper describes a symbolic algorithmic notation for description of digital computer programs that is different in one essential from the ALGOL-like languages of Western Europe and the U. S. A. The author proposes the use of a "contents of" operator and the use of symbols in statements (formulas) to describe addresses only. He also proposes recursive use of this operator (which has been used, but very infrequently, in such compiler translaters as the SHARE Assembly Program, USE Assembler, and the GAT translater in the United States) both for data (values) and functions (algorithms). Thus the contents of an address may be either a datum or the address of another algorithm. With this recursive type of notation he gives two examples: The sum of n numbers (coded in three statements), and computation and storage of the terms of an arithmetic progression (three statements). Although he states that automatization of such a procedure in an actual digital computer would not be difficult, there is no indication that a translater has been produced for a specific machine. As a result of his investigation he proposes a special accumulator in the hardware of machines to perform this addressing operation as well as other operations on addressing. A more thorough account of such a built-in procedure has been given by Schecher.

John W. Carr III, Chapel Hill, N.C.
(Courtesy *Math. Reviews*)

Machine Computations

7:

Zuhoviskii, S. I., and Leonova, V. B. Programming of an algorithm for Cebysev approximation for a finite system of inconsistent linear equations. *Luskii Derz. Ped. Inst. Nauk. Zap. Fiz.-Mat.* Ser. 6 (1958), no. 3, 21–36. (Ukrainian)

The algorithm described here is given as part of an algorithm for determining the coefficients in a Chebychev sense of the approximation $\sum_{k=1}^{n}\xi_k\varphi_k(q)$ to a continuous function $f(q)$ over an interval Q, where the n functions $\varphi_k(q)$ are to be used as approximants. Thus the values ξ_k are to be found to yield

$$\inf_{\xi_k} \max_{q\in Q} \left| \sum_{k=1}^{n} \xi_k\varphi_k(q) - f(q) \right|.$$

This problem depends on a "best approximation" solution (given here in detail) to

$$\sum_{k=1}^{n} a_{ik}\xi_k = b_i \qquad (i = 1, \cdots, m)$$

where $m > n$, yielding those values of ξ_k to give

$$\inf_{\xi_k} \max_{q\in Q} \left| \sum_{k=1}^{n} a_{ik}\xi_k - b_i \right|.$$

It is assumed the nth order minors of the determinant of the $m \times n$ matrix have non-zero determinant, and an algorithm for a series of approximations, based on a gradient method, is described in detail. The program for solution on a three-address instruction digital computer, the M-2, is described, with a flow diagram and portions of the coding included. An incomplete description of the M-2 is given.

J. W. Carr III, Chapel Hill, N. C.
(Courtesy *Math. Reviews*)

8:

Linskii, V. S. Calculation of elementary functions on automatic digital machines. *Vycisl. Mat.* **2** (1957), 90–119. (Russian)

This paper based on the work of approximation by numerous mathematicians in Western Europe and the U. S. A., and extended to fit Soviet computer needs,

collects into one place a large number of algorithms specifically for binary computers with both fixed and floating point arithmetic. The floating point algorithms are probably the most elaborate published. Most of the routines are expressed in digit-by-digit computational form (often new), Chebeychev approximations, and in the appropriate cases by second-order (i.e., Newton-like) iteration methods. The algorithms described are, for floating point: division, square root, sine, cosine, tangent, cotangent, exponential, natural logarithsm, arcsine, arctangent, and decimal-to-binary conversion and binary-to-decimal conversion. No round-off error analysis is included.

The fixed point routines are less thoroughly described, since these approximations were apparently written for the STRELA, a digital computer with only floating-point arithmetic. Complete decimal and octal coefficients for Chebychev approximations to most of the functions listed above are also available for standard ranges.

John W. Carr III, Chapel Hill, N. C.
(Courtesy *Math. Reviews*)

Machine Translation

9:

Leningrad. Universitet. Materialy po mashinnomu perevodu; sbornik 1 (Materials on Machine Translation; Collection of Articles No. 1). Leningrad, Izd-vo Leningn univ., 1958. 228 pp. 1,000 copies printed.

The book is for students, scientists, and engineers interested in machine translation. This collection of 15 articles is published as volume I of the Materials on Machine Translation. It represents the work of 25 Soviet scientists at the Leningrad University Experimental Laboratory for Machine Translation, which was created in March 1958 to continue research on translating with the aid of electronic machines. Although the present volume deals with both the theoretical and the practical aspect of machine translating, the emphasis is on the compilation of algorithms for a number of languages, many of them Asiatic. There are no references.

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(*From Introduction and Table of Contents*)

Numerical Mathematics

10:

Saul'ev, V. K. On estimation of the error in finding eigenfunctions by the method of finite differences. *Vyčisl. Mat.* **1** (1957), 87–115. (Russian)

The elliptic partial differential characteristic value problem is approximated by using first order finite (forward and backward) differences to approximate the partial derivatives. A theorem is given, in the n-dimensional case, for upper and lower bounds on pth characteristic value in the approximation as a function of p and n, using for comparison the corresponding characteristic values for the original problem and that given by the Laplace differential operator over inscribed and circumscribed cubical regions.

A second theorem, again for the n-dimensional case, bounds the maximum absolute values of the pth normalized characteristic function of the finite difference approximant in terms of p, n, and $1/h$. For a special case with $n = 2$, a special argument sharpens the latter bounds. The final result, for $n = 2$, shows the maximum value of the absolute difference between the true and approximating pth normalized characteristic function to be of $O(h^2)$ and gives the corresponding multiplier as a function of the coefficients ai, the geometry of the region, the derivatives of the first eight orders of the true solution, the distance of the true pth characteristic value from other true characteristic values, and the approximating pth characteristic value.

J. W. Carr III, Chapel Hill, N. C.
(Courtesy *Math. Reviews*)

11:

Kuntzmann, J. Evaluation de l'erreur sur un pas dans les methodes à pas separes. *Chiffres* **2** (1959), 97–102. (English, German, and Russian summaries)

The author produces a sequence of formulas expressing the error in a single step, using any of the Runge-Kutta type integration procedures for second-order differential equations, in terms of the values of the numerical solution at the present, preceding, and following points. The analysis is based on certain relations between the values of an arbitrary function and its derivatives at equally spaced points. Formulas with errors of increasing order, up to 7, in the step-size h, are given. He suggests that this technique is more useful in practice than those formulas involving higher partial derivatives of the functions on the right-hand side, and states that the various formulas have proved useful in practice.

John W. Carr III, Chapel Hill, N. C.
(Courtesy *Math. Reviews*)

12:

Derwidué, L. Introduction a l'algebre supérieure et au calcul numérique algébrique. Masson et Cie., Paris; Sciences et Lettres, Liège; 1957. 431 pp. 6000 fr.

This book combines the areas of classical numerical analysis, classical theory of equations, and higher algebra into a very unusual combination. Starting at "The Mechanization of Algebraic Calculation", it first gives a description of how to use a desk calculator in manipulating numbers and then polynomials. It then describes computations with complex numbers, classical manipulations with determinants and those methods of solution of linear equations that prove most useful with desk calculators. Almost no discussion of iterative procedures is given.

A chapter on polynomials includes their description in interpolatory form, the classical solution of equations of the third and fourth degree, and decomposition of rational fractions.

The chapter on the theory of systems of algebraic equations contains a very thorough description of the theory for systems of two equations in two unknowns, and terminates with a brief introduction to algebraic geometry, as applied to more complicated systems. Accompanying it is a very thorough account of the present state of knowledge of techniques for numerical solution of such systems, with a number of problems worked out by hand. The remaining chapters of the book, with one exception, give a formal introductory account of abstract group theory, and an introduction to the theory of finite, symmetric and linear groups, and rings, ideals, fields, vector spaces, and algebras.

The one remaining chapter gives a thorough account of the stability criteria of Routh, Hurwitz, and Schur, and the appendix adds some recent work of the author's.

The book seems aimed at scientists or engineers who are faced with manipulation of polynomials in practical situations, probably servomechanism designers, because of the emphasis on stability. It does not, unfortunately, relate any of the ideas or techniques to large-scale digital computing machinery, or describe effects of inherent or propagated error on solutions. Finally, because the final theory comes at the end with no motivation, it leaves the reader unsatisfied as to how it fits into the whole. Nevertheless, for this class of engineers and those numerical analysts who would like an algebraic source-book of theory on almost any type of work with polynomials, this deserves consideration. *J. W. Carr III*, Chapel Hill, N. C.
(Courtesy *Math. Reviews*)

13:

Filin, A. P. Interpolation polynomials for functions of several variables. *Prikl. Mat. Meh.* **21** (1957), 678–688. (Russian)

The author develops explicit relationships, in terms of determinantal recurrence formulas, for transferring from the Lagrangian equal-interval interpolation form of a polynomial into the standard coefficient description. He sketches the treatment for a polynomial in one variable, and then describes the extension of this process to a polynomial in several variables.

In particular, he presents tables used directly in calculating the coefficients from the functional values at equal intervals, for polynomials of up to degree four. He then carries through a computation, using these tables, for a polynomial in three variables of degree two, determining the 27 coefficients in terms of the values at a cubic, equally-spaced gird of 27 lattice-points in three space. The major contribution here appears to be the technique and tables for explicitly performing this translation from values to coefficients. *John W. Carr III*, Chapel Hill, N. C.
(Courtesy *Math. Reviews*)

Technological Effect of Computers and Cybernetics

14:

Kitov, A. I., and Kriniskii, N. A. Elektronnye vycislitelnye mashiny. (Electronic calculating machines). Naukno-Populyarnaya Seriya. Izdat. Akad. Nauk SSSR, Moscow, 1958. 131 pp. 1.90 rubles. (Russian)

This book is published by the Academy of Sciences USSR, under the editorship of Academician A. A. Dorodnitsyn, with a printing of 25,000 copies. It is a satisfactory and effective popularization, at an extremely low price, of the techniques and state of the Soviet digital (and to a lesser extent, analog) computer art. Of particular interest is the inclusion of the use of such machines under the heading of "cybernetics", which scientists in the USSR have taken from Norbert Wiener's book of the same name.

After an introduction and definition of cybernetics, the book discusses information theory and its applications, the transformation of information, and self-regulating systems. The construction and design of computers is

represented by the MN-2 Analog Computer and the STRELA, BESM, and URAL digital computers. An introduction to the basis of digital computer programming makes use of the Strela instruction code, and relative address coding.

In the discussion of digital computers there are brief accounts of Soviet work on automatic programming, machine translation, and game-playing programs. The book predicts a wide extension of the use of such computers as an aid to scientists' and engineers' difficult mental tasks of all tasks, as well as the advent of the automatic factory. It is unfortunate that the authors' choice of examples of U.S. work in such areas were of the more flamboyant type, but this can probably be blamed on lack of communication.

At present there appears to be no comparable popular book on computers of this recent vintage in Western Europe or the U. S. A., except for Raymond's similar book (MR *20*, 4357).

J. W. Carr III, Chapel Hill, N. C.
(Courtesy *Math. Reviews*)

15:

Aleksandrov, V. The prospects for development of electronic mathematical machines (Perspektivy razvitiya elektronnykh matematicheskikh mashin). *Radio*, 1958. Nr. 12, 5–6. (Russian)

The author states that electronic mathematical machines are one of the most effective means of automating production; the Communist Party and the Soviet Government are paying great attention to them. According to N. S. Krushchev's report at the 21st Party Congress on the Seven-Year-Plan (1959–1965), electronic mathematical machines are to be widely introduced for controlling technological processes in various branches of industry, initially in the chemical and metallurgical industries. A general description of the various functions of electronic mathematical machines in industrial processes is given; it is stated that successful experiments have been carried out in the Soviet Union with these machines for automatic control of an electric train according to a pre-set chart. In the next few years it is planned to produce machines capable of carrying out thousands and ten of thousands of operations per second. There is one photograph.

(*Translated from the Abstract*)

16:

Loskutov, V. I. The near future in computing Technique. *Priborostroyeniye* (Instrumentation), 1959, Nr 1, 5–6. (Russian)

According to the 7-year plan the production of computing machines is to be increased by the 4.7 fold and amount to 2.1 billion rubles in 1965. In the near future rapidly operating machines will be produced in series and perform 5,000–20,000 operations per second. This means already a considerable success as compared to the figures 100 and 2000 which are characteristic of the machines "URAL" and "STRELA", etc. Within two to three years, however, so great a progress must have been made that machines can be produced which perform 100,000–200,000 operations per second and which have a capacity of storing 8,000–32,000 figures. Those machines deserve particular attention which render possible an economical analysis of the process to be automatized. The best solution of this problem seems to be an intensified network of the mathematical computing centers over the whole country and to entertain a staff of qualified mathematicians working with the most modern machinery in the mentioned centers. Mathematical control machinery has a great future. These machines are inserted in the automation system and can automatically control any complex dependence of the individual parameters of the process to be controlled and compute and (or) transmit the correct results through control signals with the necessary speed. Such machines are to be employed particularly in the fields of oil petroleum, chemical, and nonferrous metal industry, as well as for technical problems of railway transport. As soon as the mathematical problems of the processes to be controlled are definitely worked out and as soon as it is possible to insert corresponding transducers into the course of the process there will be sufficient information for the control machine to guarantee an increased output and reduce the production cost simultaneously with an improvement of quality. (*Translated from the Abstract*)